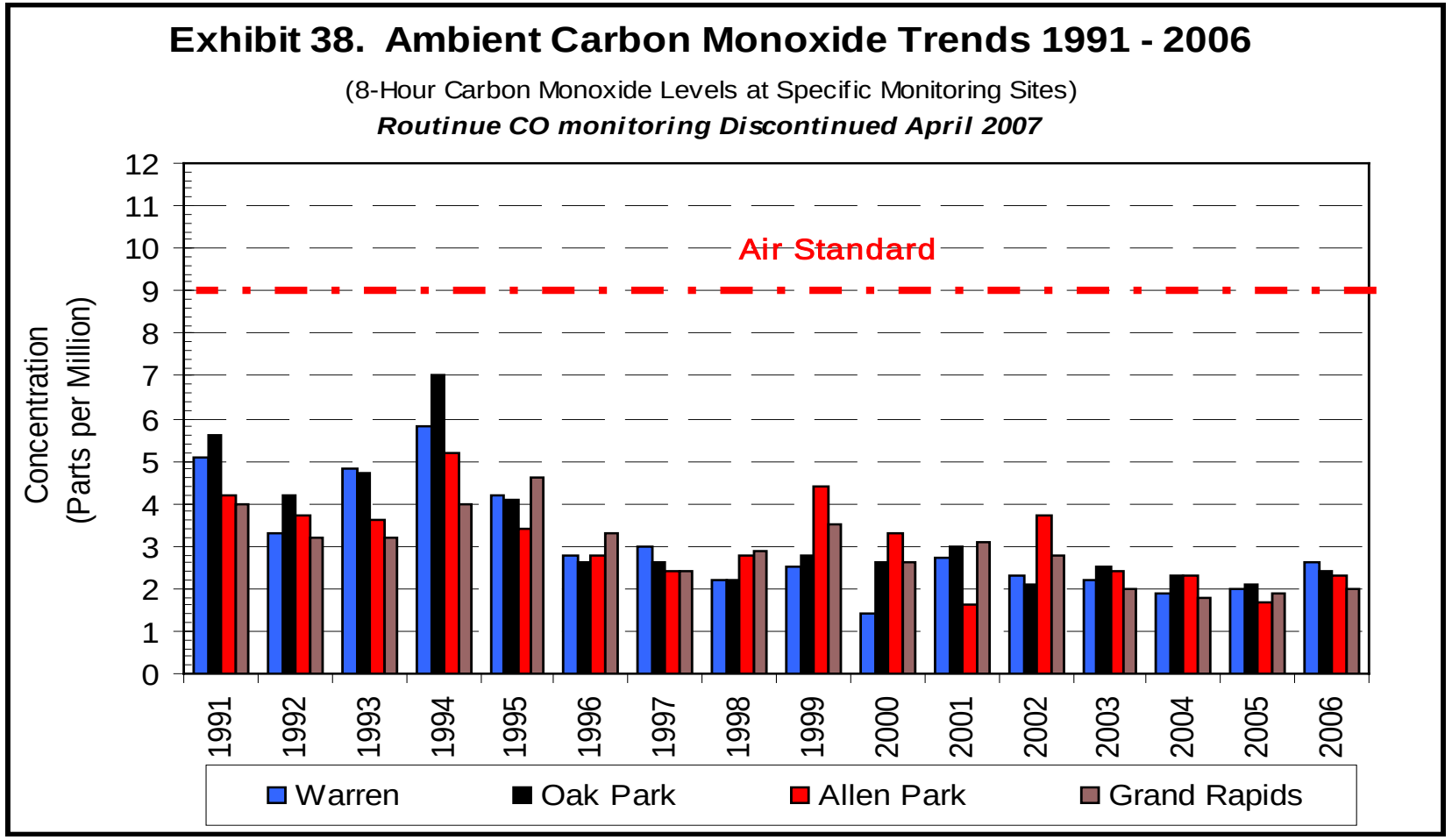
Ambient Levels of Criteria Air Pollutants

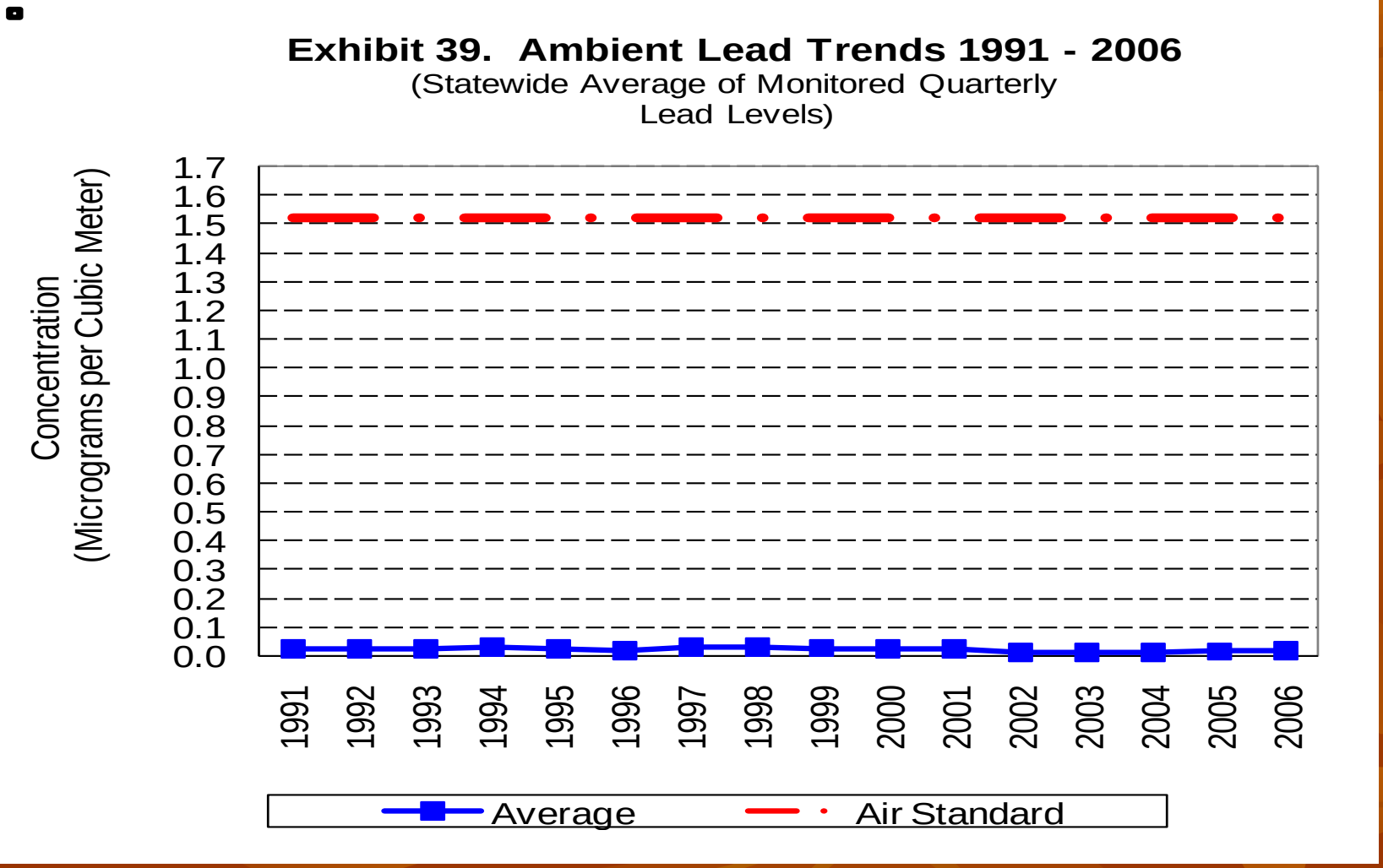
Criteria Air Pollutants:

- Carbon Monoxide
- Lead
- Nitrogen Dioxide
- Sulfur Dioxide
- Ozone
- Particulate Matter

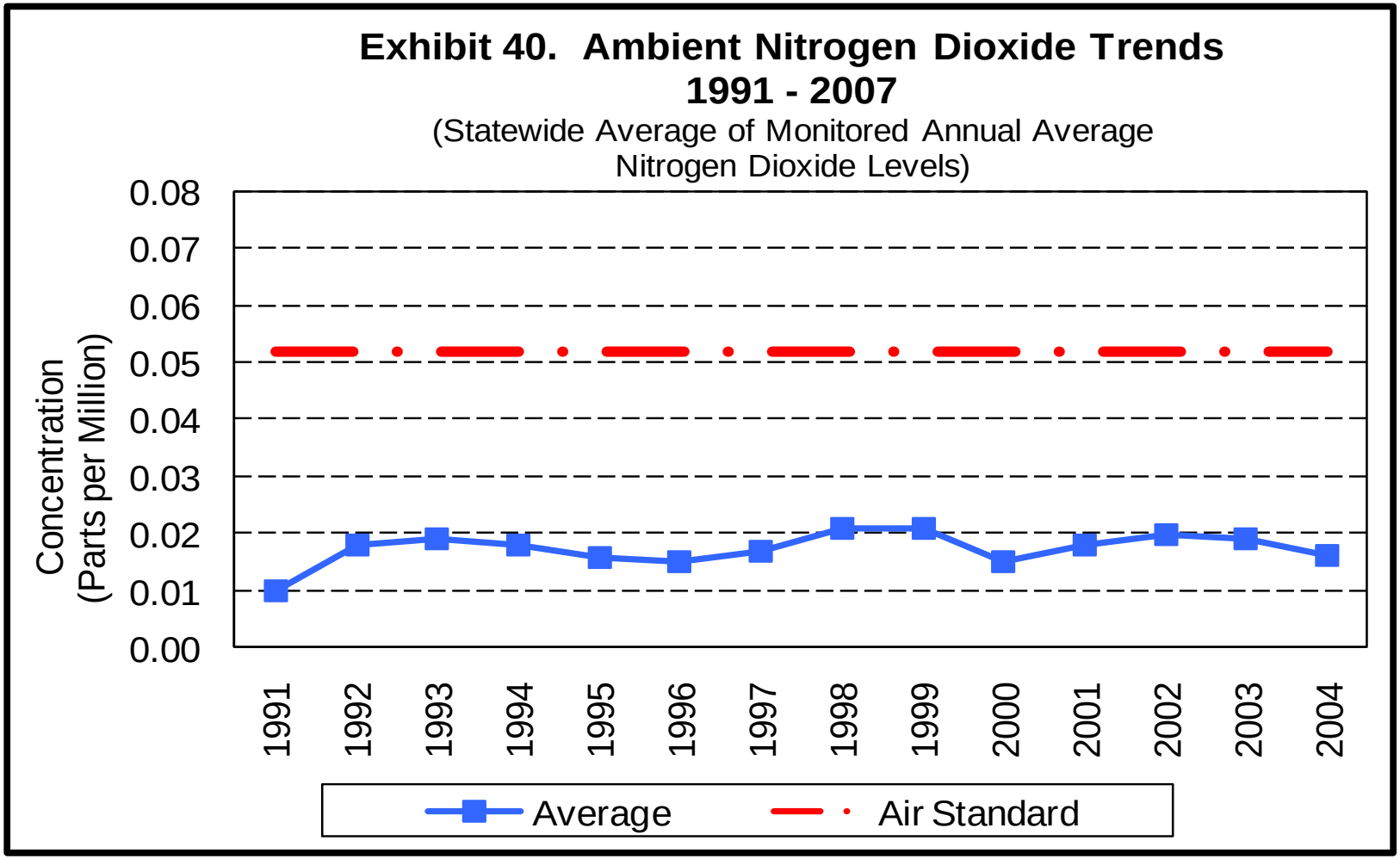
Environmental Measures – Physical/Chemical Indicators



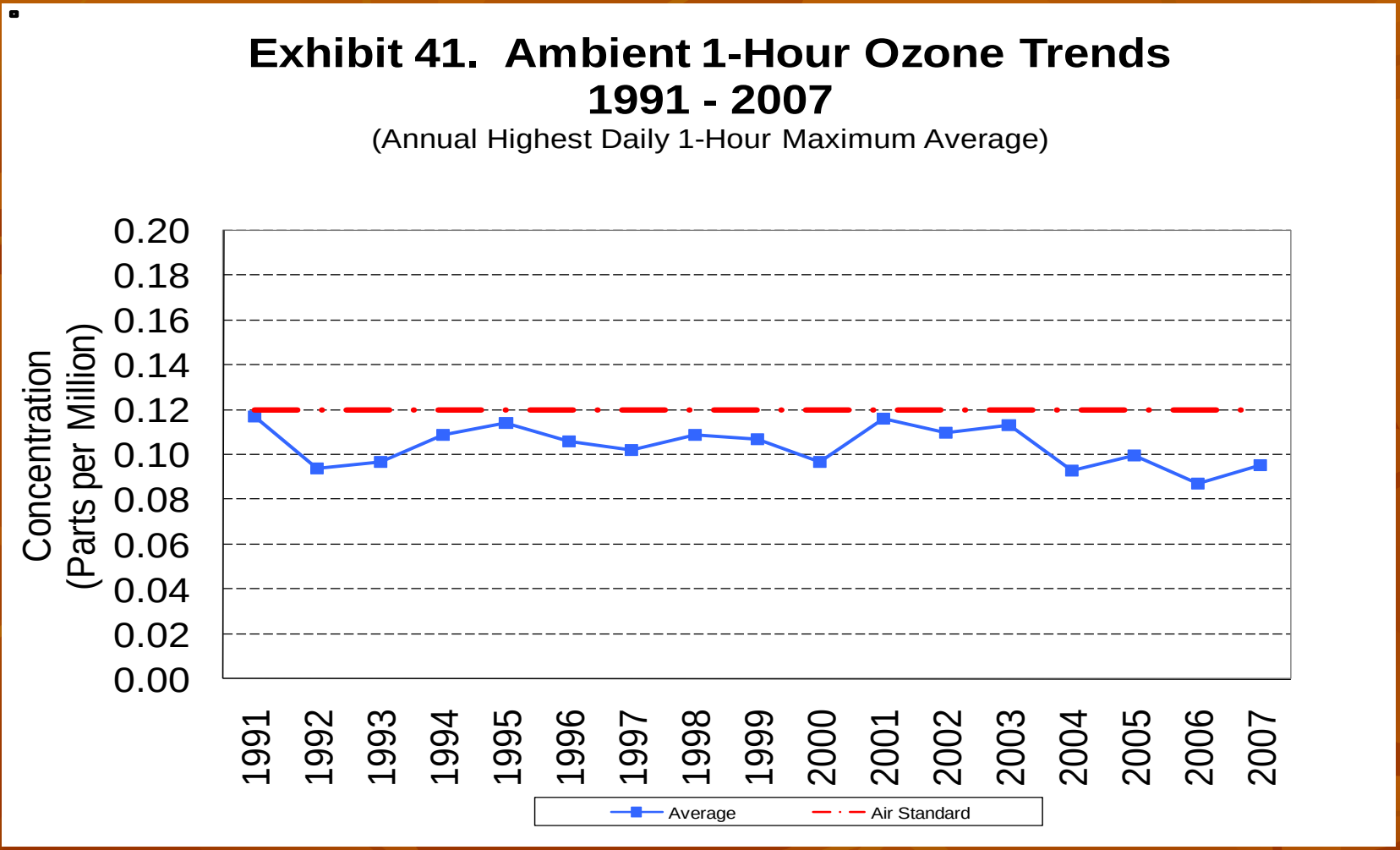
Environmental Measures – Physical/Chemical Indicators



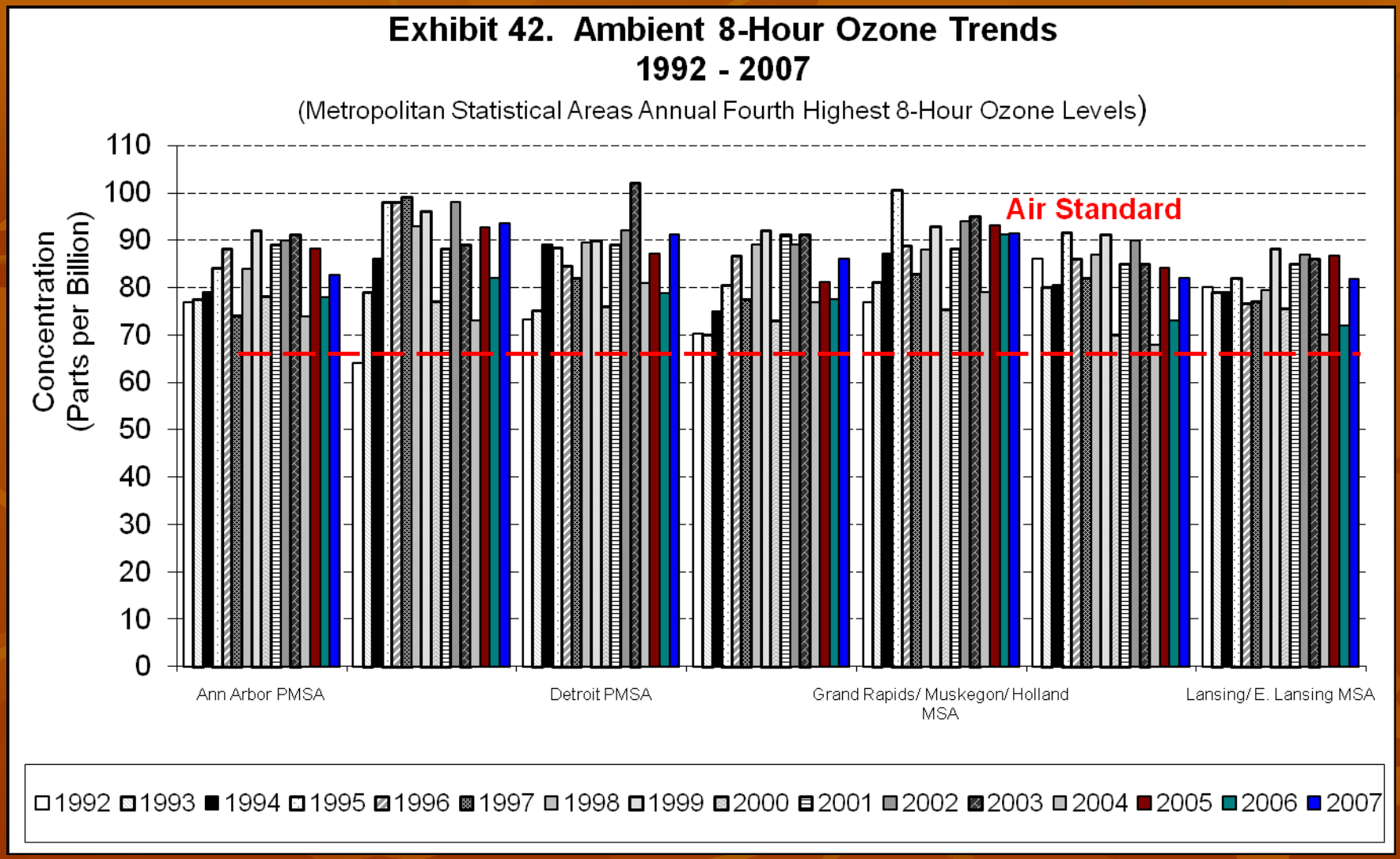
Environmental Measures – Physical/Chemical Indicators



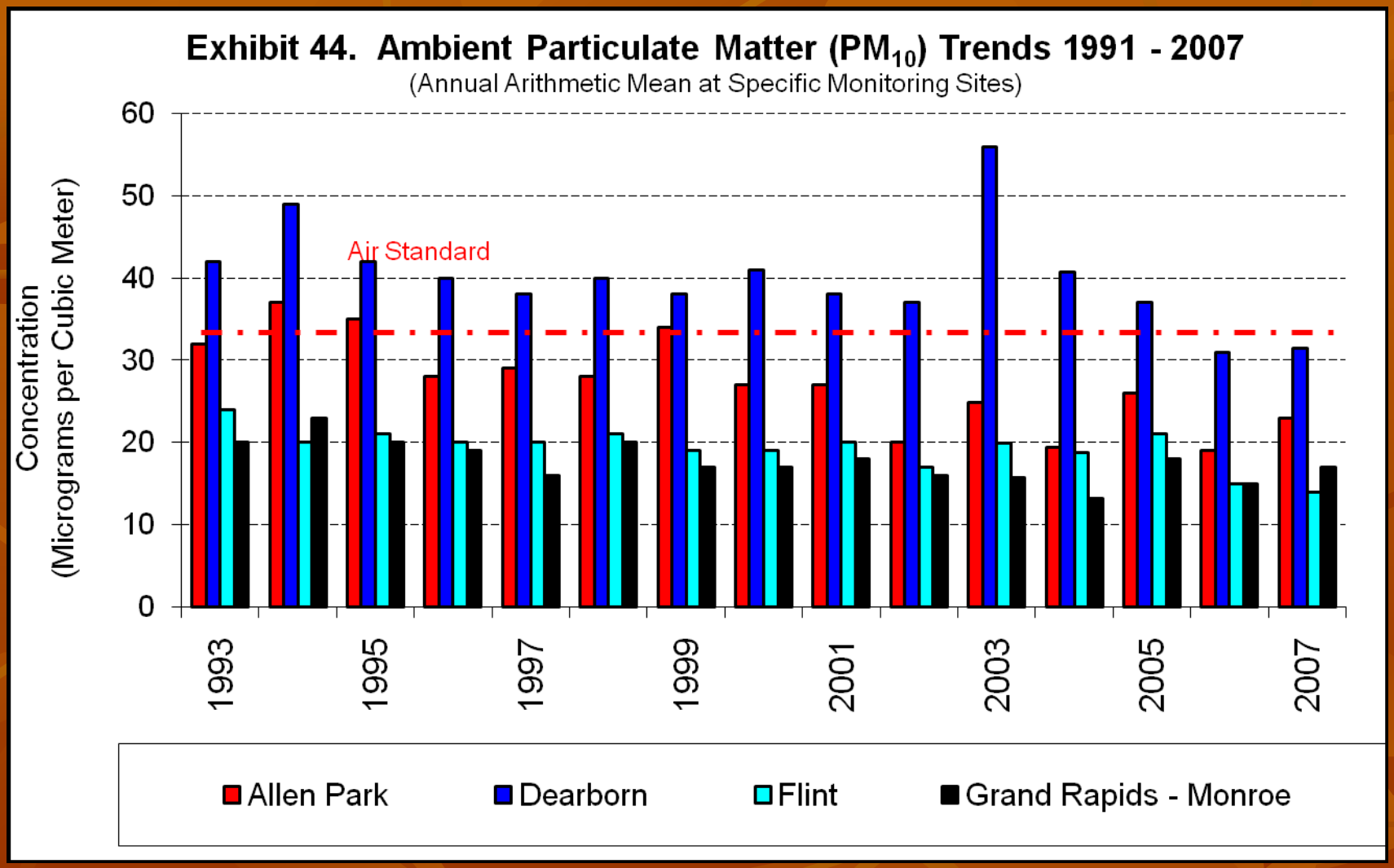
Environmental Measures – Physical/Chemical Indicators



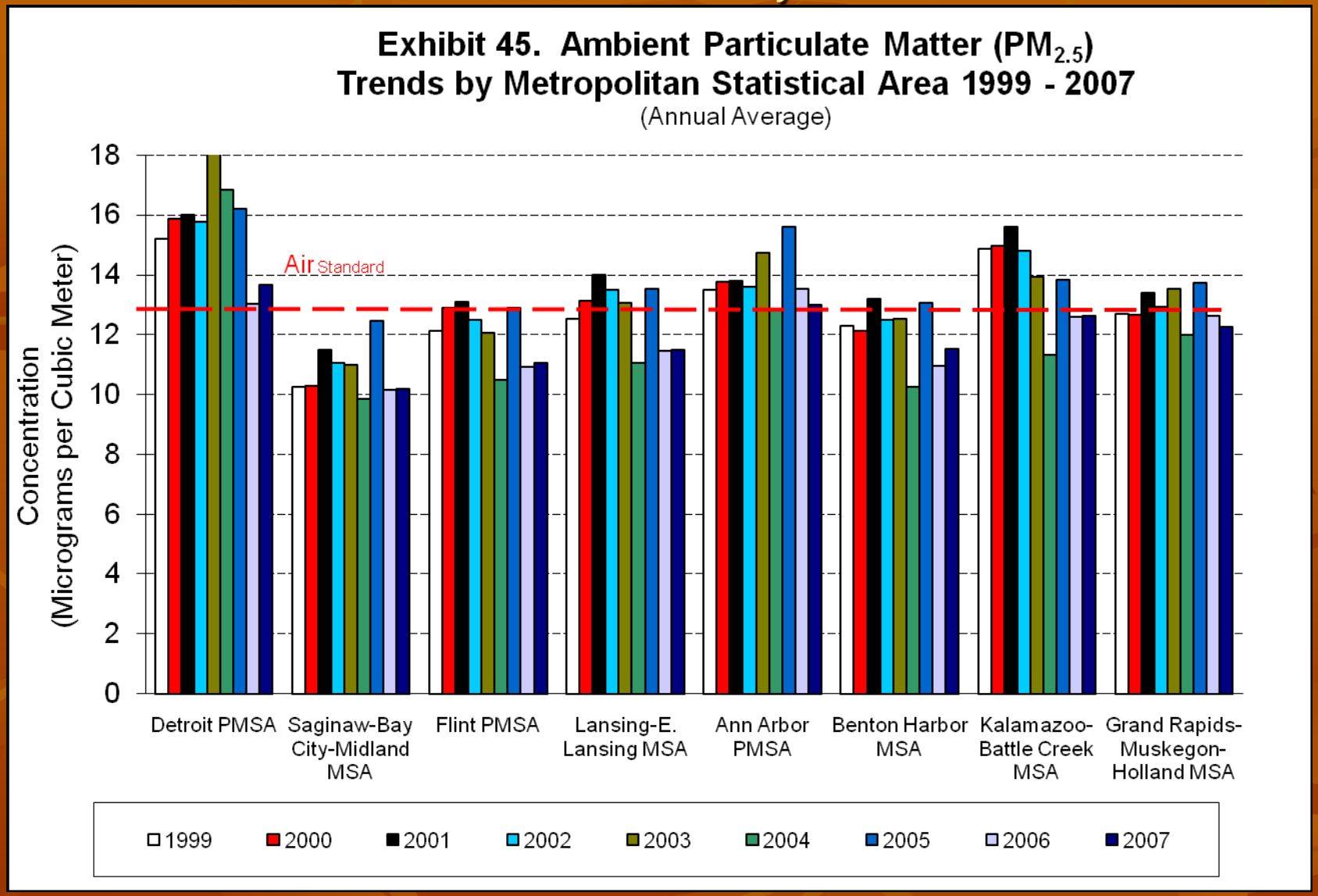
Environmental Measures – Physical/Chemical Indicators



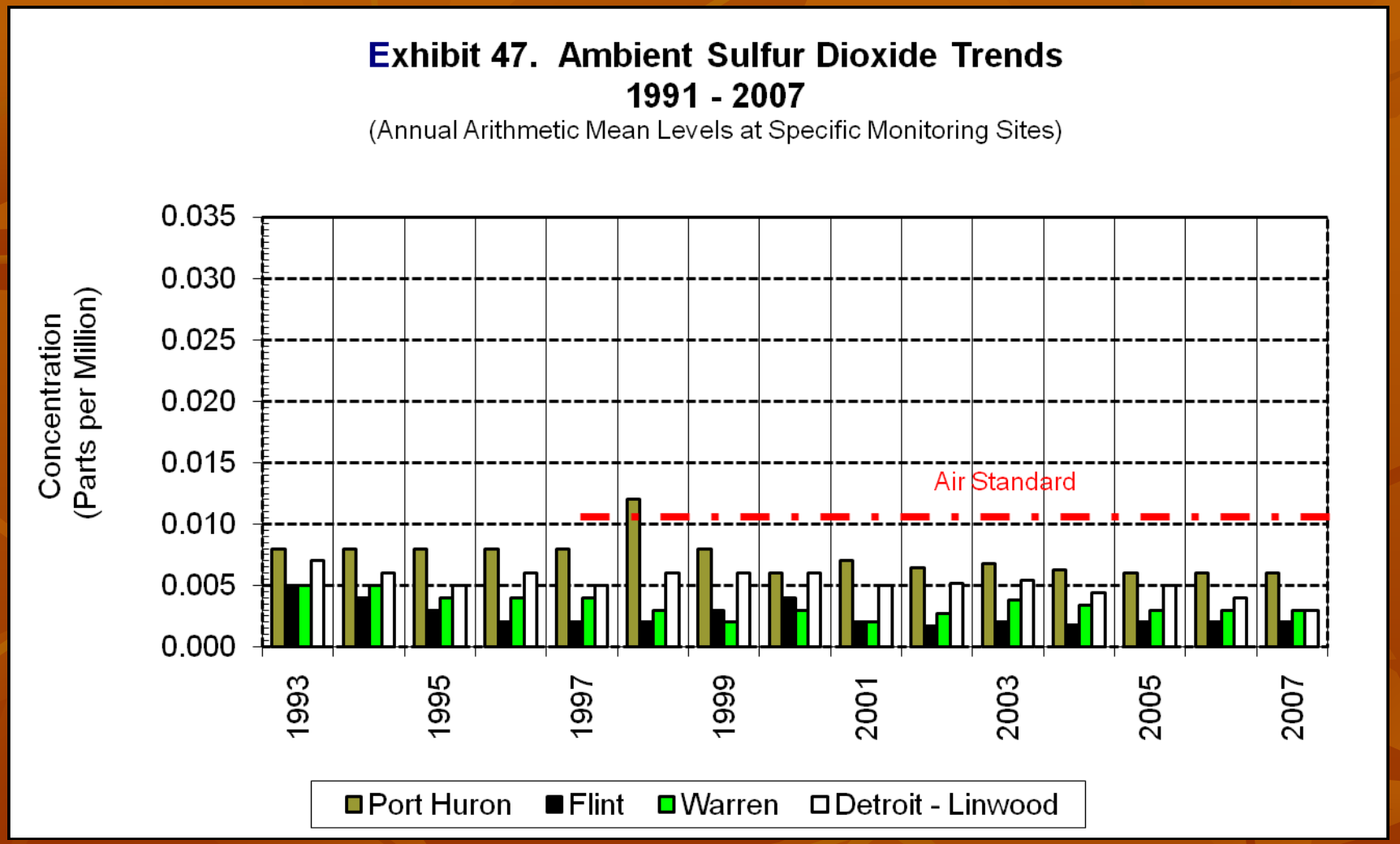
Environmental Measures – Physical/Chemical Indicators



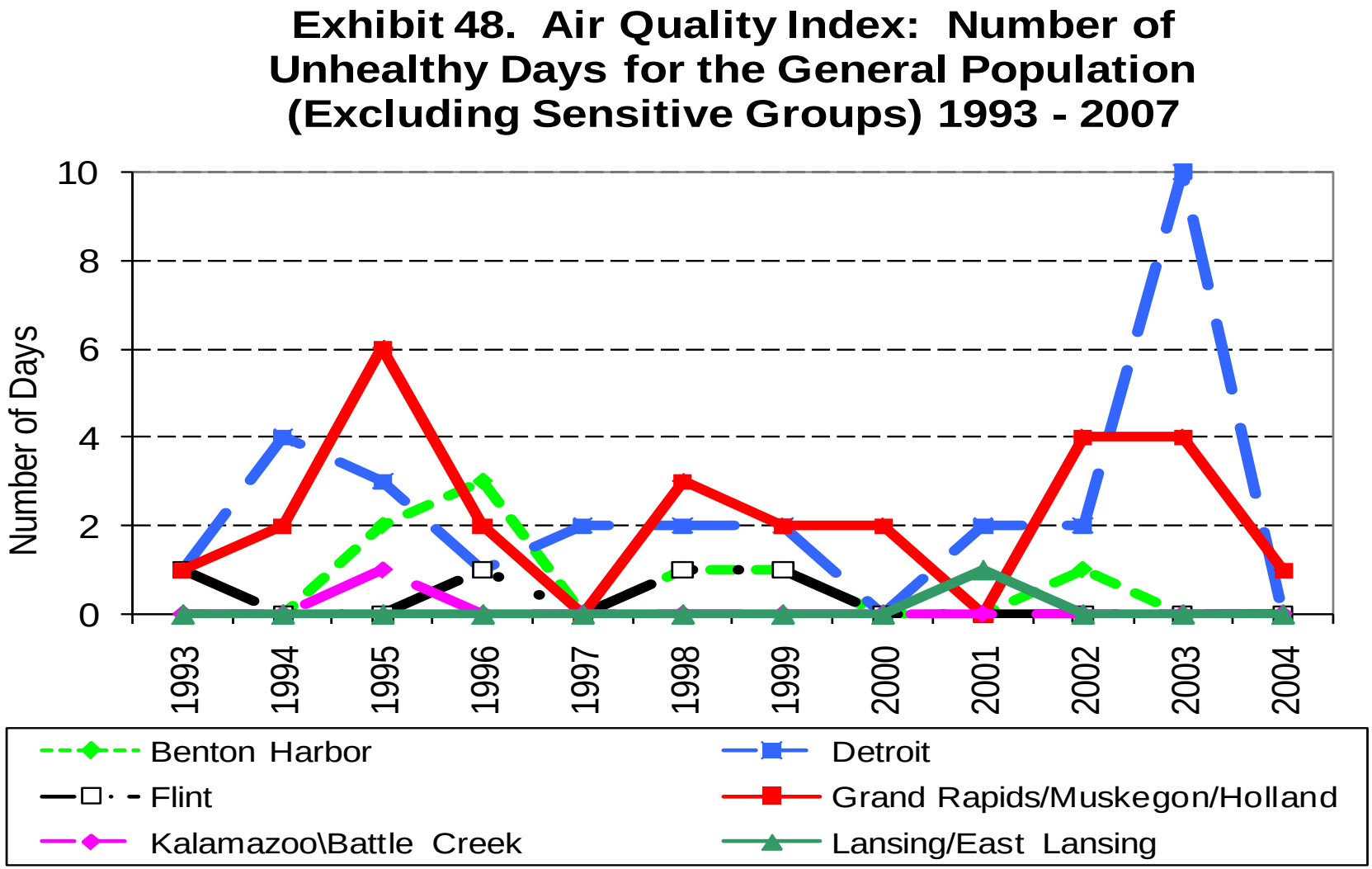
Environmental Measures – Physical/Chemical Indicators



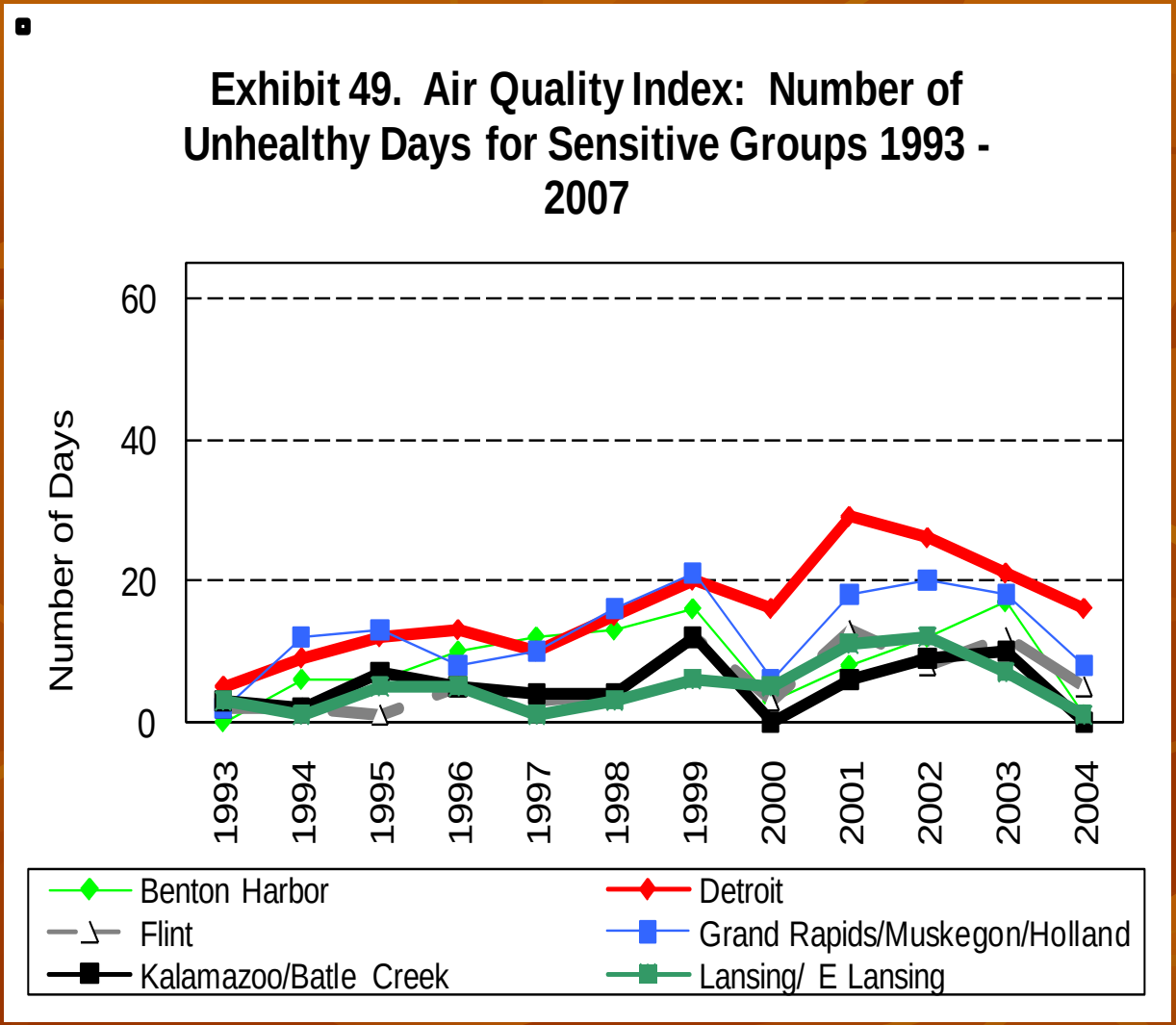
Environmental Measures – Physical/Chemical Indicators



Environmental Measures – Physical/Chemical Indicators



Environmental Measures – Physical/Chemical Indicators



- In 1999, the Air Quality Index was recalculated based on the revised air quality standards for ozone and fine particulate matter ($PM_{2.5}$).
- These changes resulted in a higher number of days that were considered to be *unhealthy* for sensitive groups.

Ambient Levels of Air Toxics Contaminants and Rates of Deposition of Persistent and Bioaccumulative Air Toxics

- There are many more atmospheric contaminants than just six criteria pollutants. Michigan is currently monitoring 50 toxic organics and 13 trace metals. With cuts to the DEQ's air monitoring budget, the state's air toxics monitoring program has been reduced.
- Some air toxics also can persist and bioaccumulate in the environment. The state has developed a strategy to monitor for mercury, PCB, and dioxin-like substances in five urban sites, two agricultural areas and two background areas.
- Additional information on both these initiatives can DEQ's Internet Site (www.michigan.gov/deqair).

Inland Lake Water Quality

Biological productivity refers to the amount of plant and animal life that can be produced within a lake. A lake's ability to support plant and animal life defines its level of biological productivity.

Low productive lakes are generally deep and clear with little aquatic plant growth. These lakes tend to support coldwater fish, such as trout and whitefish.

Highly productive lakes are shallow, turbid, and support abundant aquatic plant growth. These lakes support warm water fish, such as bass and pike.

Environmental Measures – Physical/Chemical Indicators
Productivity Classification of Lakes

Exhibit 50. Historical Classification of 730 Michigan Public Lakes

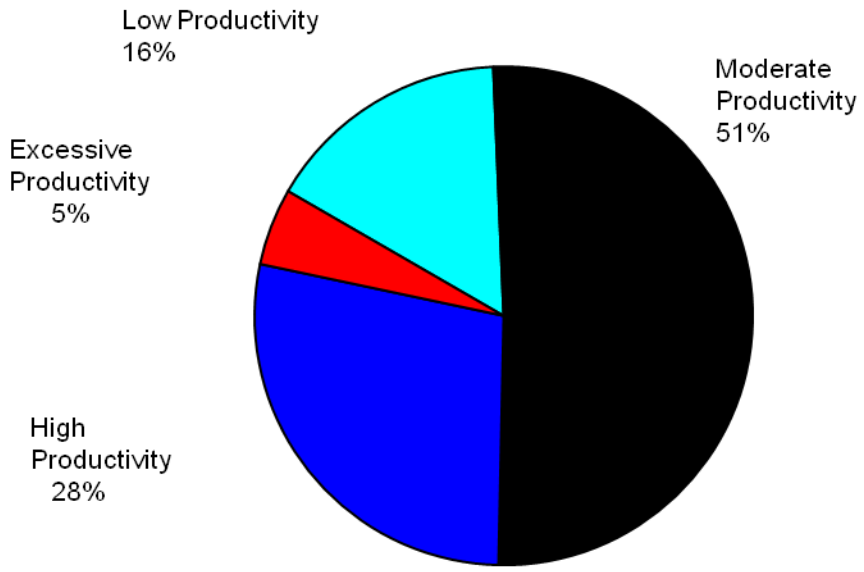
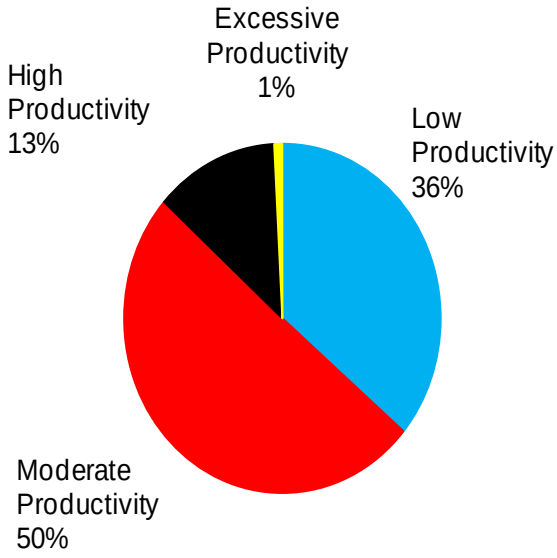


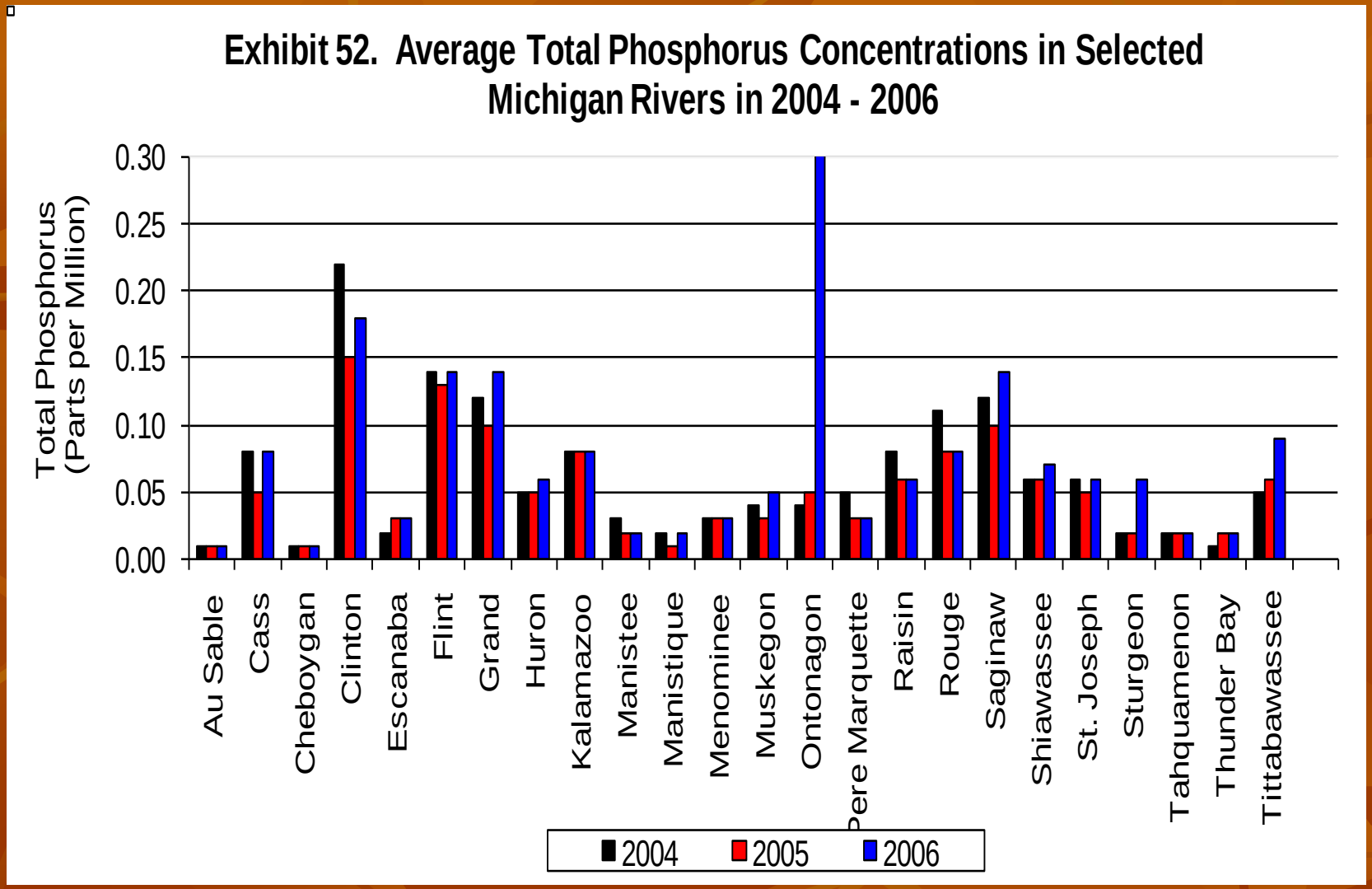
Exhibit 51. Classification of 119 Lakes Monitored through Michigan's Cooperative Lakes Monitoring Program during 2006 - 2007



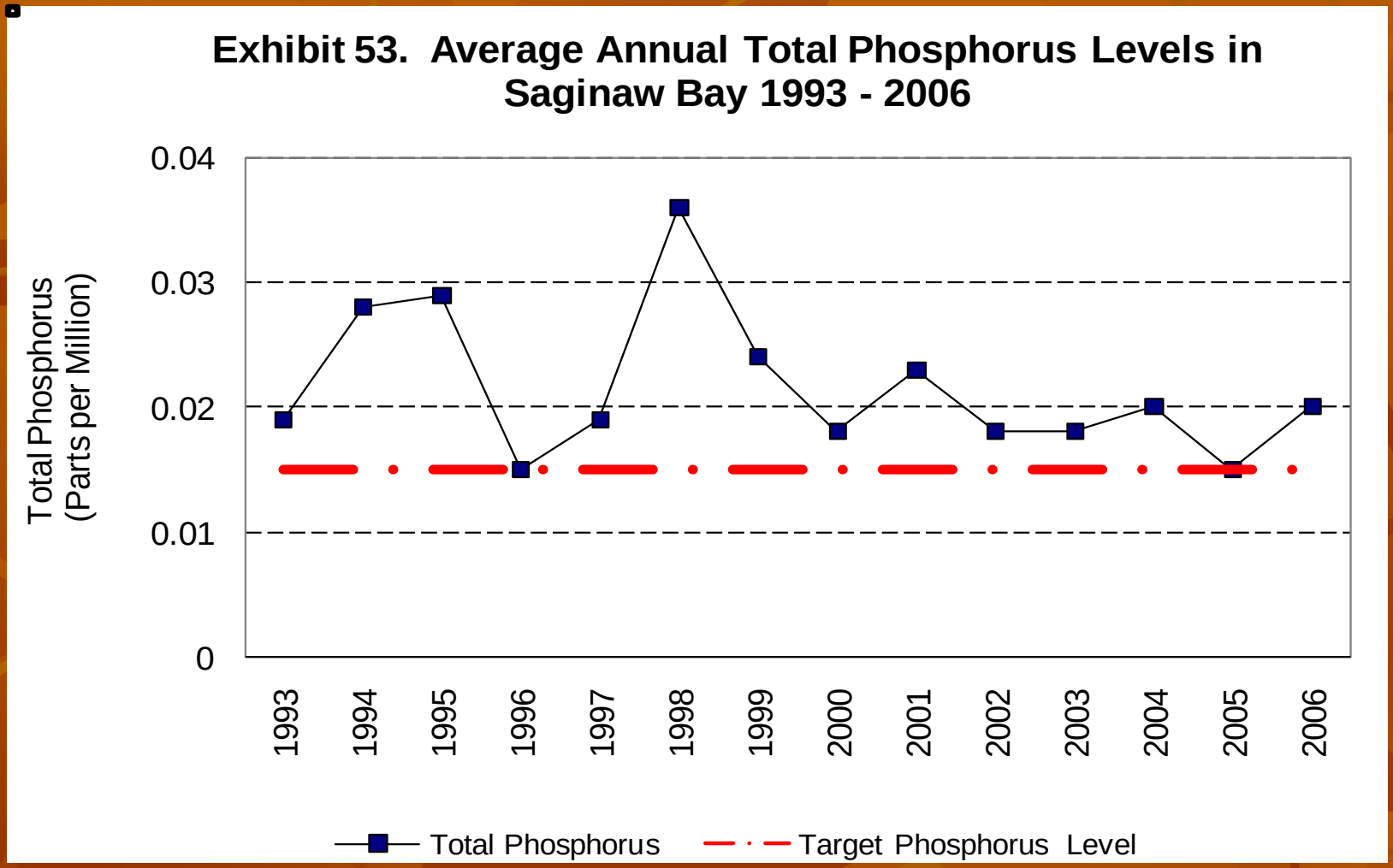
Surface Water Chemistry

- The DEQ collects water samples from 24 major rivers, Saginaw Bay, Grand Traverse Bay, and the Great Lakes connecting channels.
- The samples are analyzed for a variety of nutrients and heavy metals, including total phosphorus and total mercury.
- Phosphorus is key nutrient that affects algal growth and productivity and mercury, once in the form of methymercury is a major contaminant of fish.

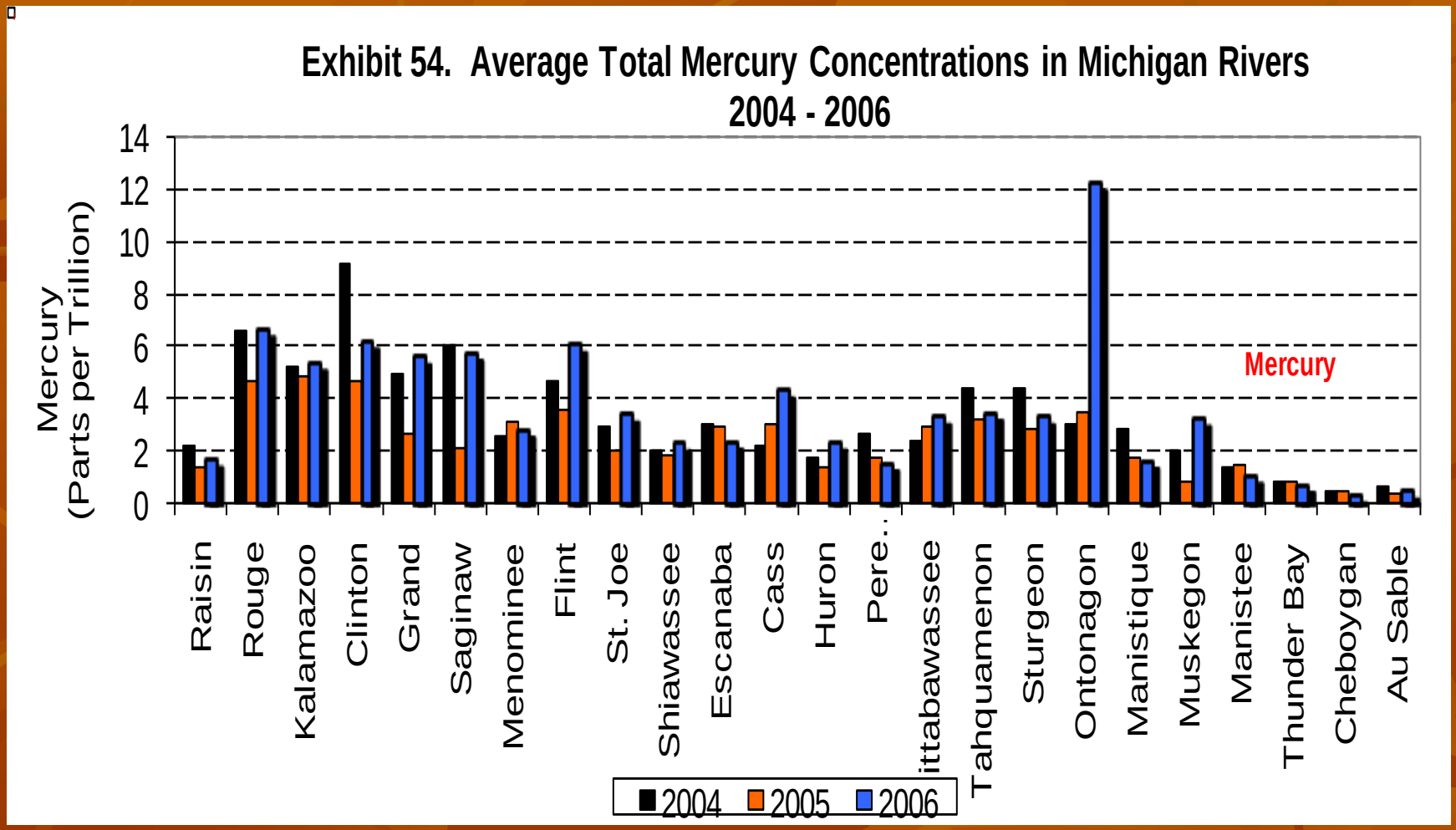
Environmental Measures – Physical/Chemical Indicators



Environmental Measures – Physical/Chemical Indicators



Environmental Measures – Physical/Chemical Indicators

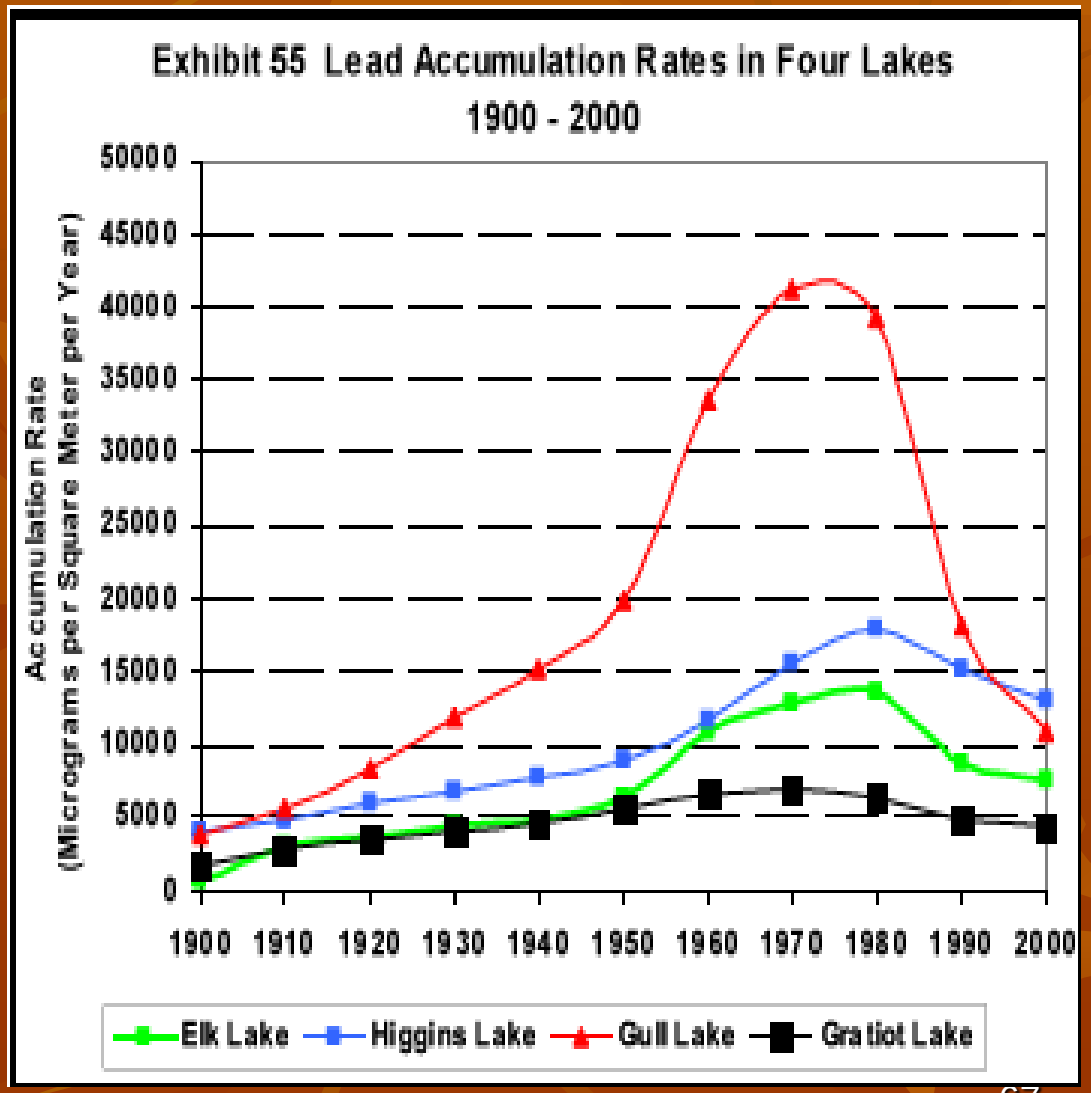


Environmental Measures – Physical/Chemical Indicators

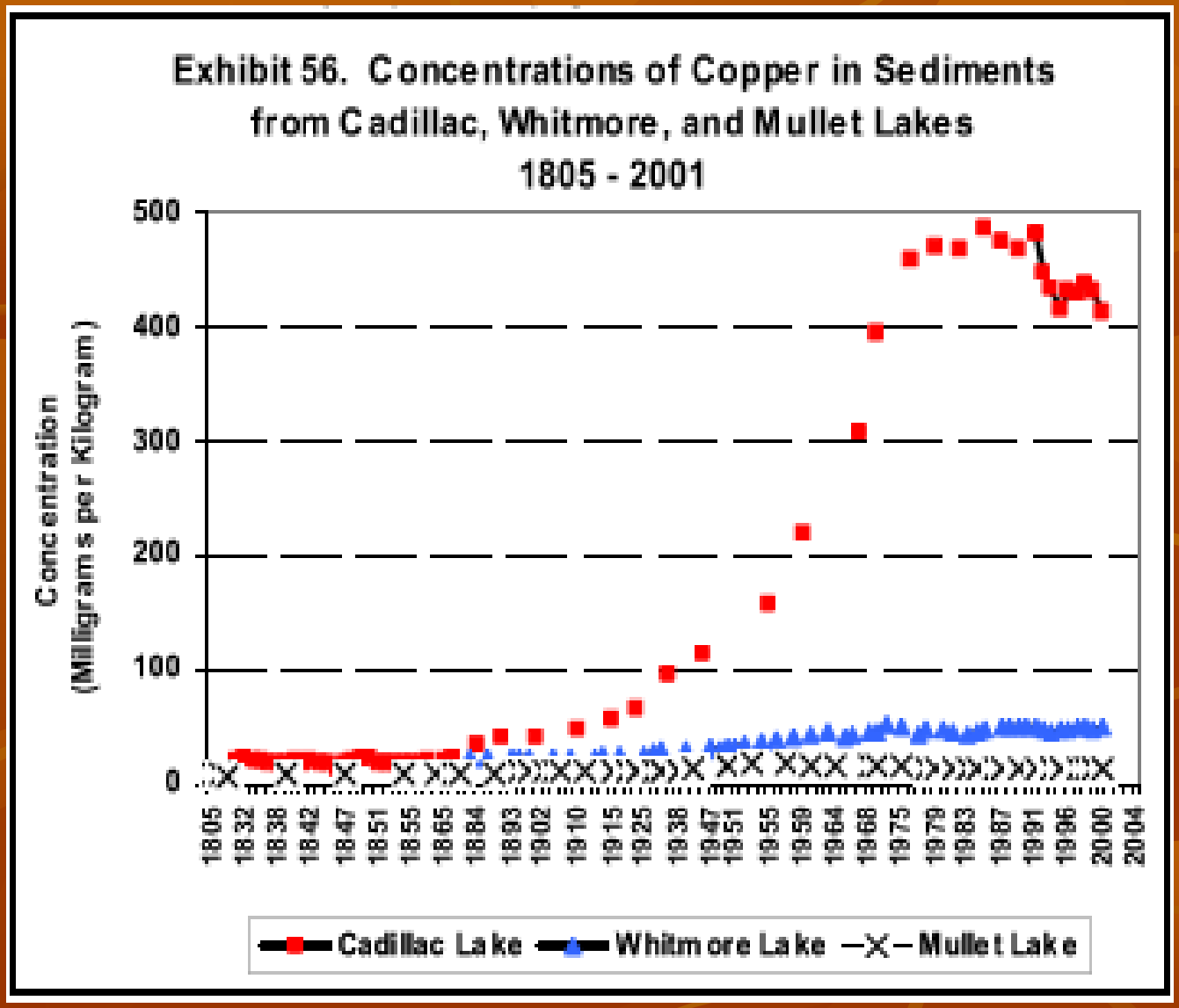
Inland Lake Sediments

Measuring trends in the accumulation of toxic chemicals in sediments are useful to assess the overall quality of aquatic systems.

As material is deposited on the bottom of lakes over time, the sediments serve as a chemical recorder of temporal trends of toxic contaminants.



Environmental Measures – Physical/Chemical Indicators



The steep increase in copper in Cadillac Lake is thought to be due the frequent use of copper sulfate to remove algae from the lake .

Environmental Measures – Physical/Chemical Indicators

Stream Flow

- Stream flow is an indicator of the amount of habitat available for fish and other aquatic organisms.
- The USGS maintains 150 gauging stations on Michigan streams. However, these are not representative of all Michigan's stream types.
- The DNR is currently working with the University of Michigan to develop a scientifically supportable protocol for the selection of reference stations that could serve to provide baseline flow patterns.

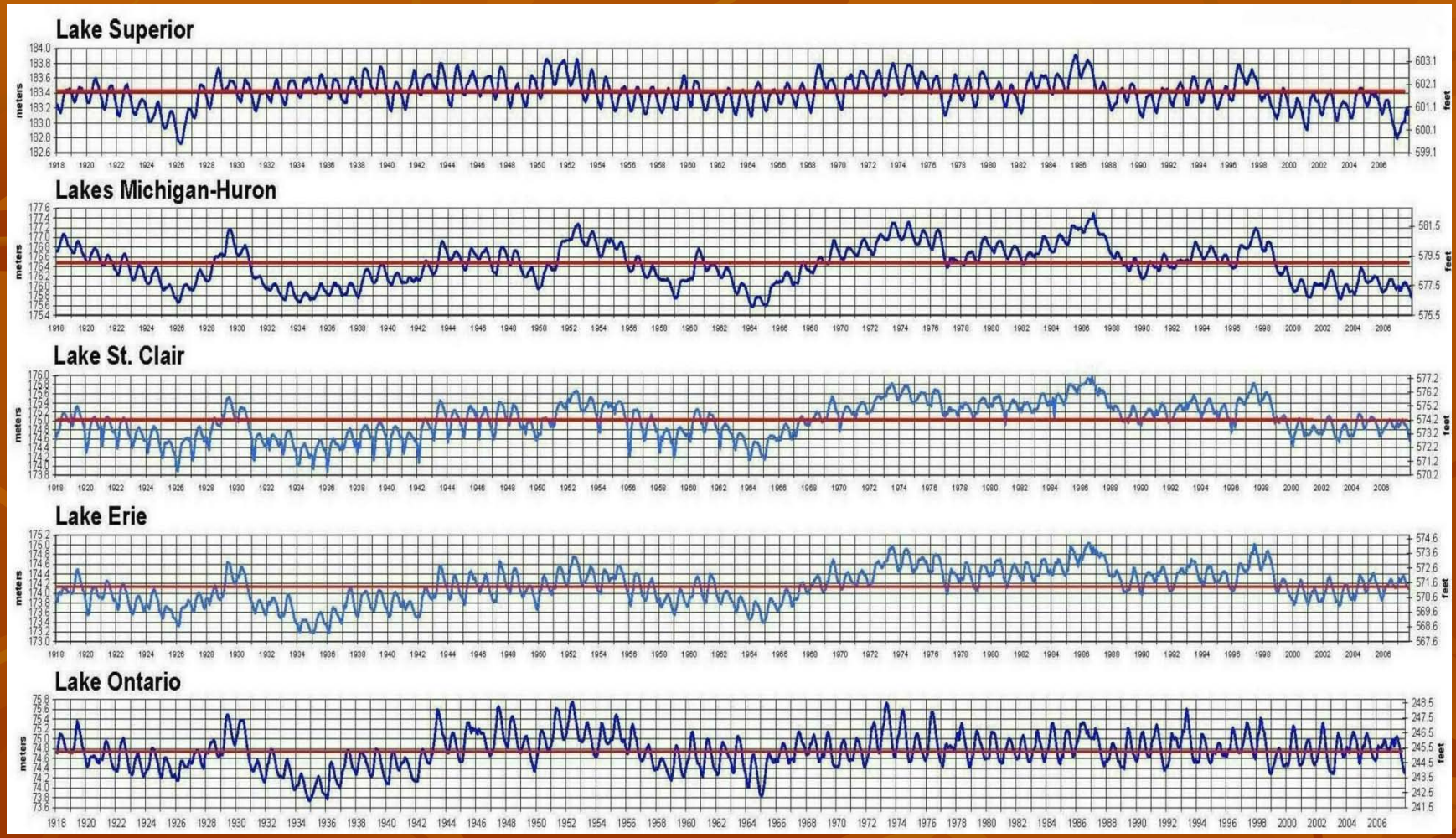
Environmental Measures – Physical/Chemical Indicators

Trends in Great Lakes Water Levels

Great Lakes water levels are highly sensitive to cyclic fluctuations

Environmental Measures – Physical/Chemical Indicators

Great Lakes Water Levels 1918 - 2007



Low levels occurred in the mid-1920s, mid-1930s, and early 1960s. High levels occurred in 1929 - 1930, 1952, 1973 - 1974, 1985 - 1986, and 1997 – 1998.

Environmental Measures – Physical/Chemical Indicators

Great Lakes Water Level

- Great Lakes water levels are dictated primarily by precipitation and evaporation, which are in turn controlled by climate and weather.
- Cyclic variability in climate and weather will continue to have a significant impact on the natural levels fluctuations of the Great Lakes regardless of human intervention.
- Humans, however, can intensify these impacts through activities such as dredging, diversions, and large consumptive uses.
- These human activities are currently being addressed by the Council of Great Lakes Governors and other affected Great Lakes stakeholders.

Environmental Measures – Physical/Chemical Indicators

Trends in Great Lakes Ice Cover

Exhibit 61. Great Lakes Mean Ice Coverage 1970 – 1999

Lake	1970 - 1979	1980 - 1989	1990 - 1999	Change from 1970s to 1990s
Erie	94.5%	90.8%	77.3%	-17.2%
Huron	71.3%	71.7%	61.3%	-10.0%
Michigan	50.2%	45.6%	32.4%	17.8%
Ontario	39.8%	29.7%	28.1%	-11.7%
Superior	74.5%	73.9%	62.0%	-12.6%

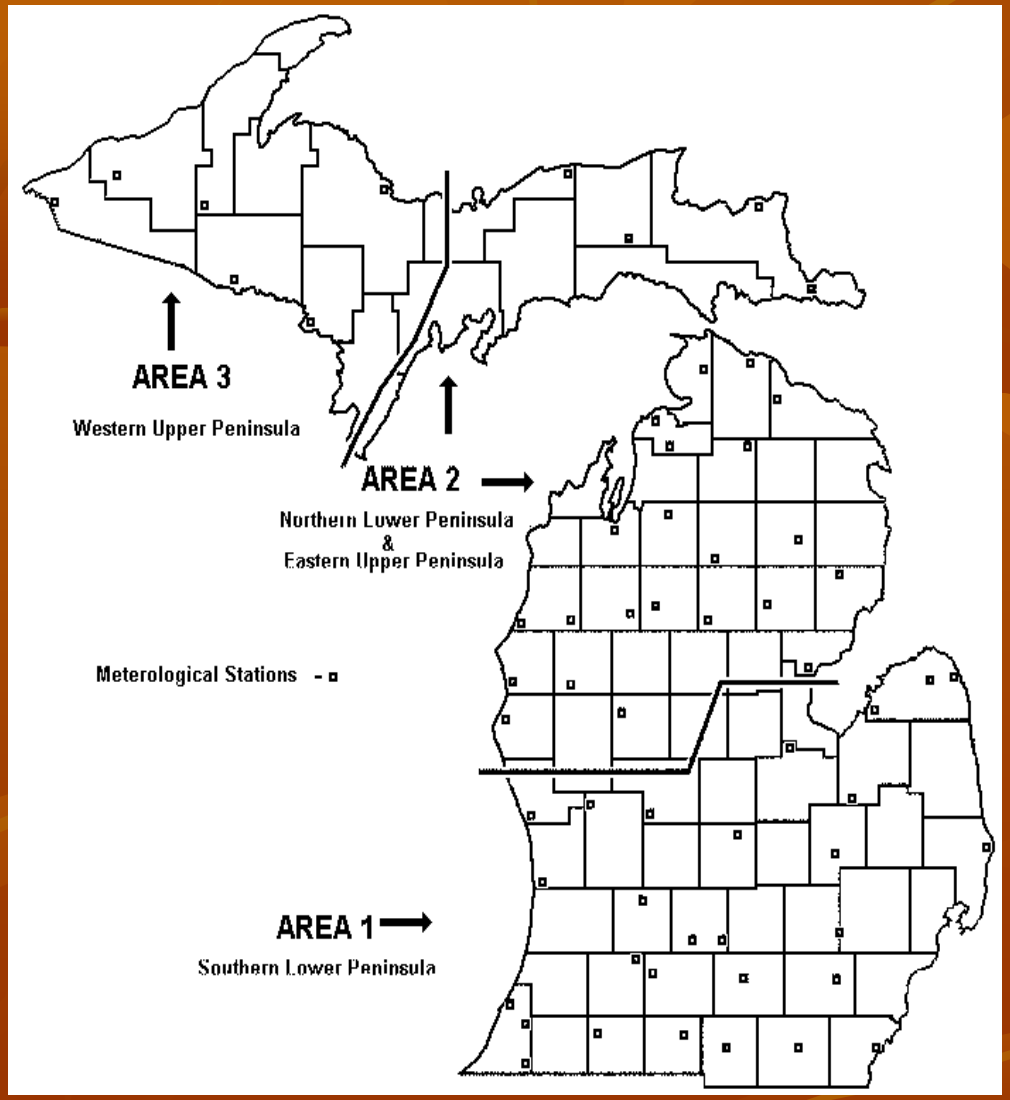
Source: Ferris, G. 2003. Ice duration on the Great Lakes indicator #4858, pp 71-72. In *State of the Great Lakes 2003*. State of the Lakes Ecosystem Conference, Environment Canada and U.S. Environmental Protection Agency. 102p.

Environmental Measures – Physical/Chemical Indicators

Climate and Weather Trends

Since the last glaciation, 11,300 year ago, Michigan's climate has significantly warmed and cooled many times, greatly influencing the numbers and distributions of the state's plant and animals.

Environmental Measures – Physical/Chemical Indicators



The state's climate may be characterized by three broad weather patterns.

Area 1 tends to be the warmest with a long frost-free season, and more rain in the spring.

Area 2 tends to be cooler, have a shorter frost-free season and greater snow fall.

Area 3 tends to be the coolest, with high winds, greatest snowfall, and severe thunderstorms.

Environmental Measures – Physical/Chemical Indicators

Climate is an important indicator because:

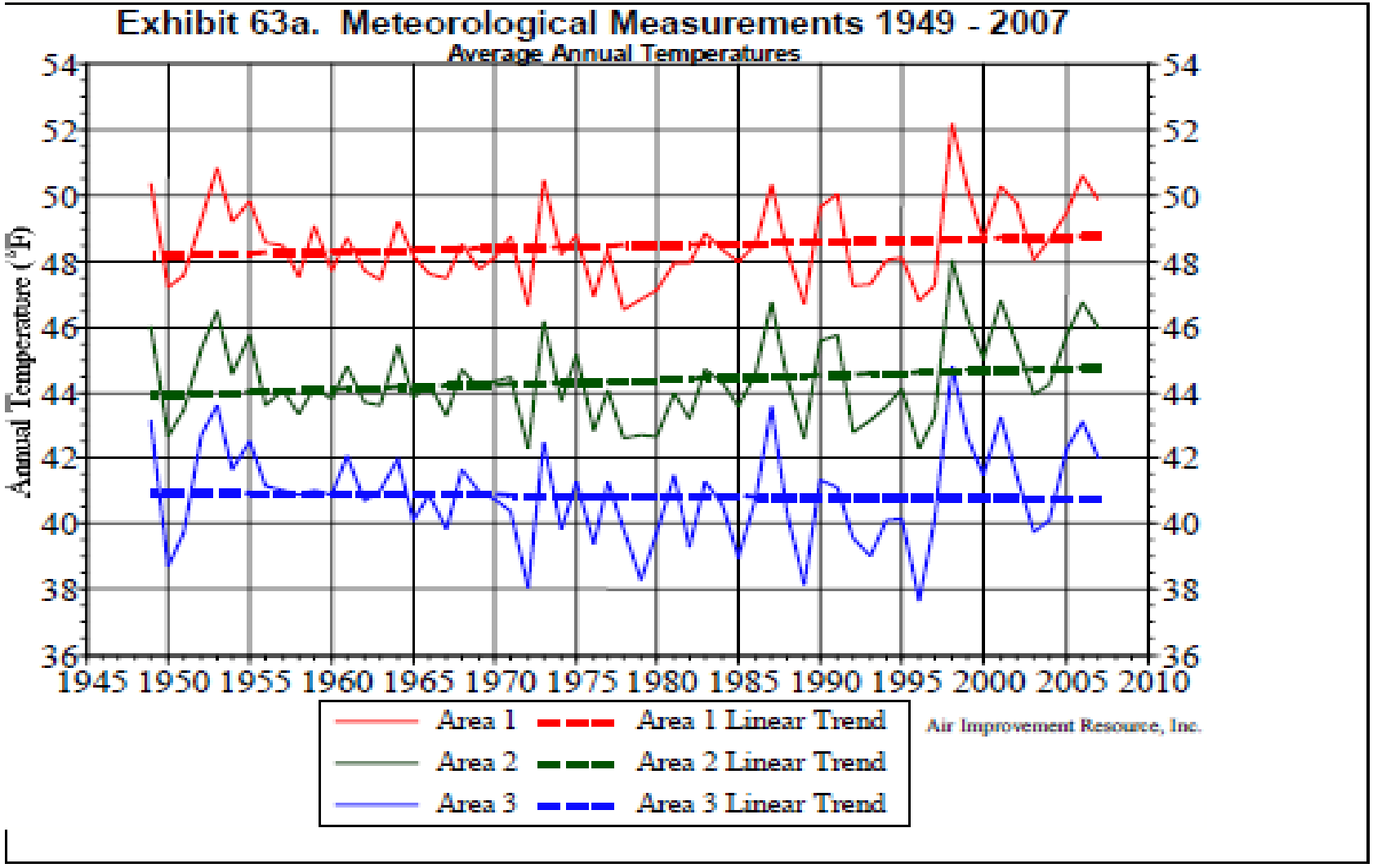
- Michigan is both the southern and northern extent of several ecosystem types and impacts a wide variety of plants and animals, and

Nine meteorological measures are tracked:

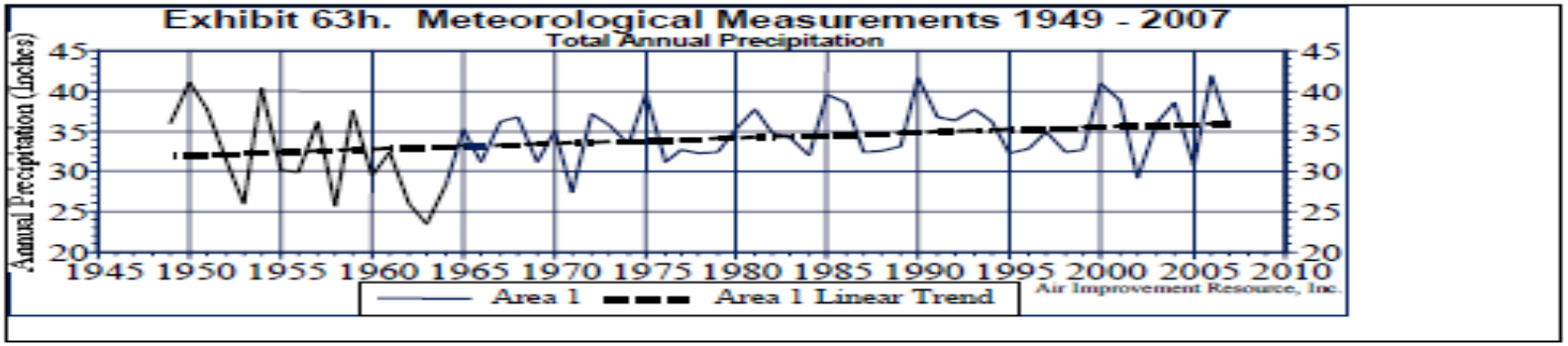
Annual Avg. Temperature
Total Annual Precipitation
Annual Avg. Daily Maximum Temperature
Total Annual Snowfall
Length of Growing Season
Annual Avg. Daily Minimum Temperature
Avg. Diurnal Temperature Change
Cooling Degree Days
Heating Degree Days

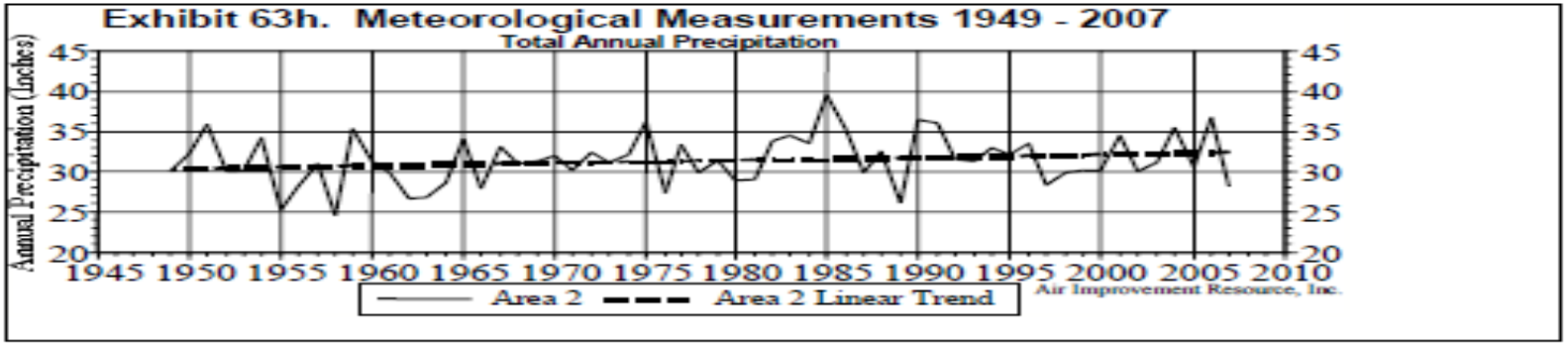
Environmental Measures – Physical/Chemical Indicators

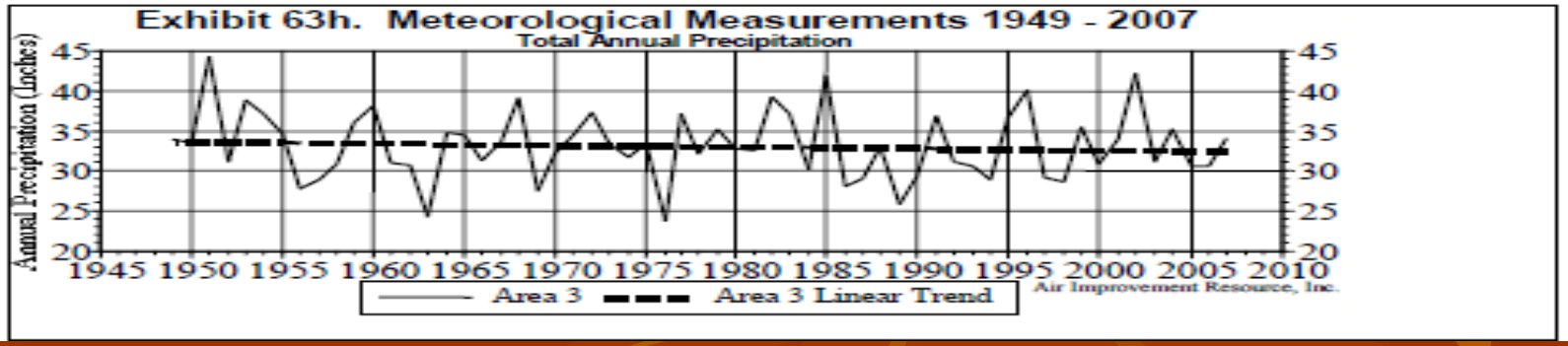
Average Annual Temperature 1949 - 2007



Environmental Measures – Physical/Chemical Indicators
Total Annual Precipitation 1949 - 2007

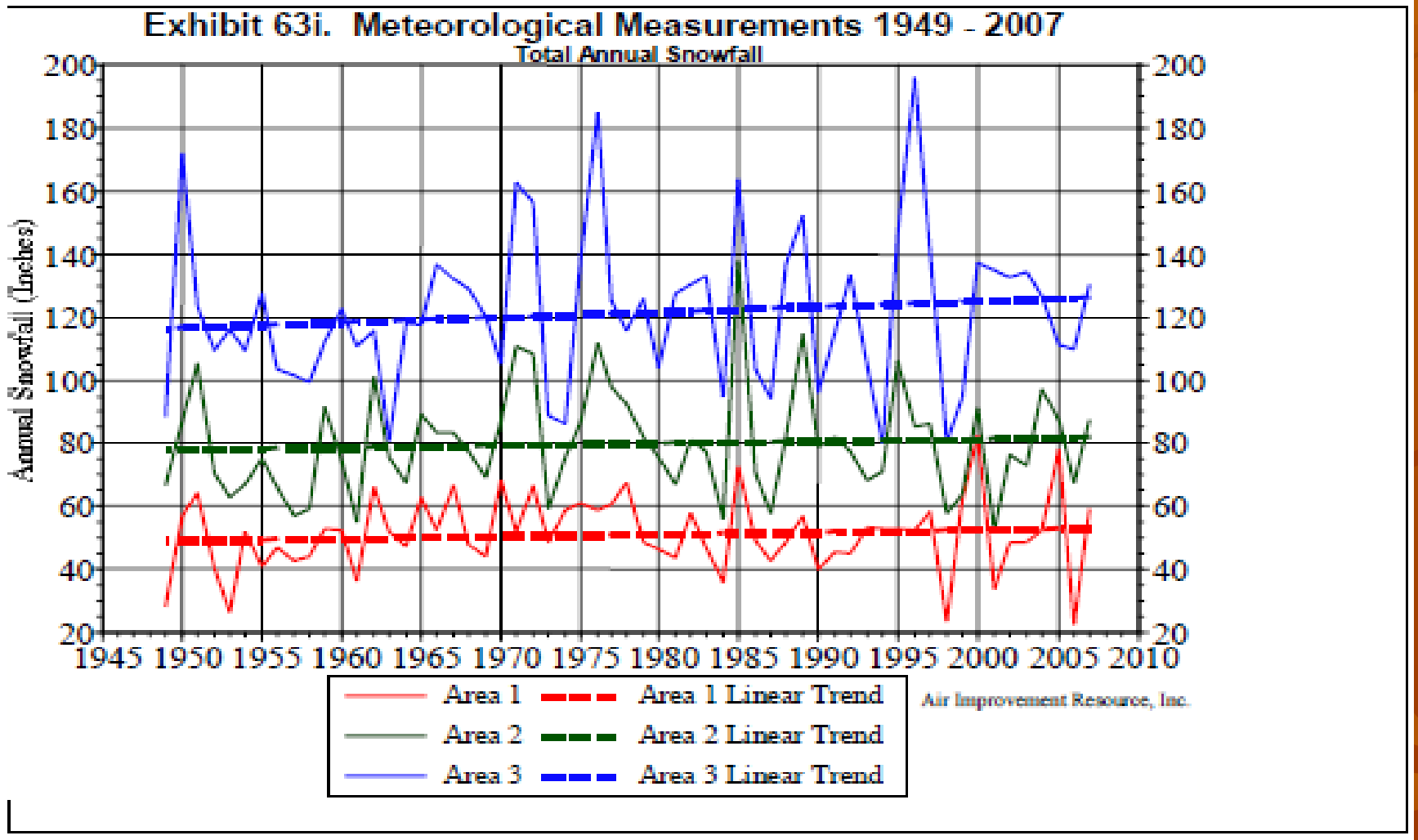




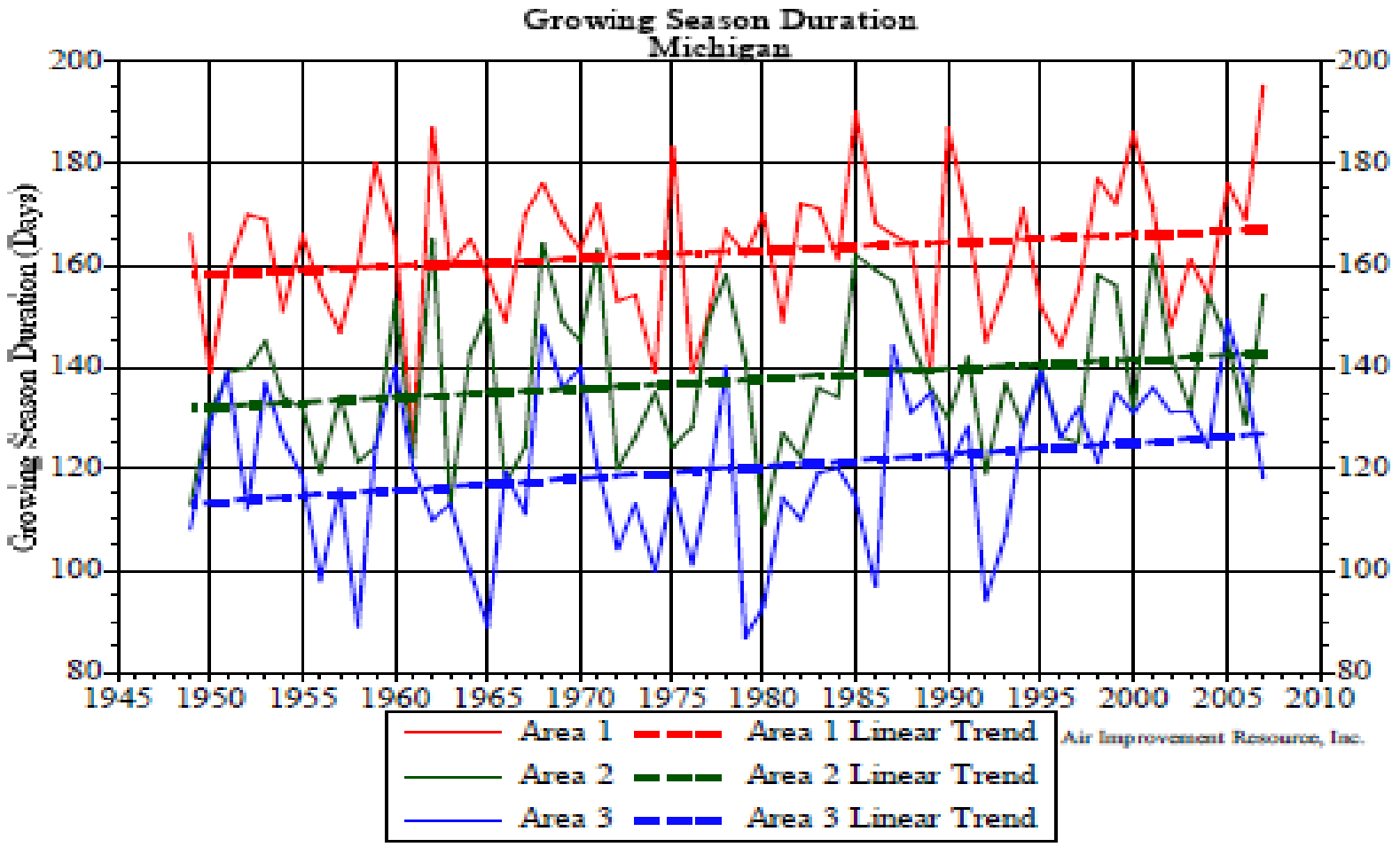


Environmental Measures – Physical/Chemical Indicators

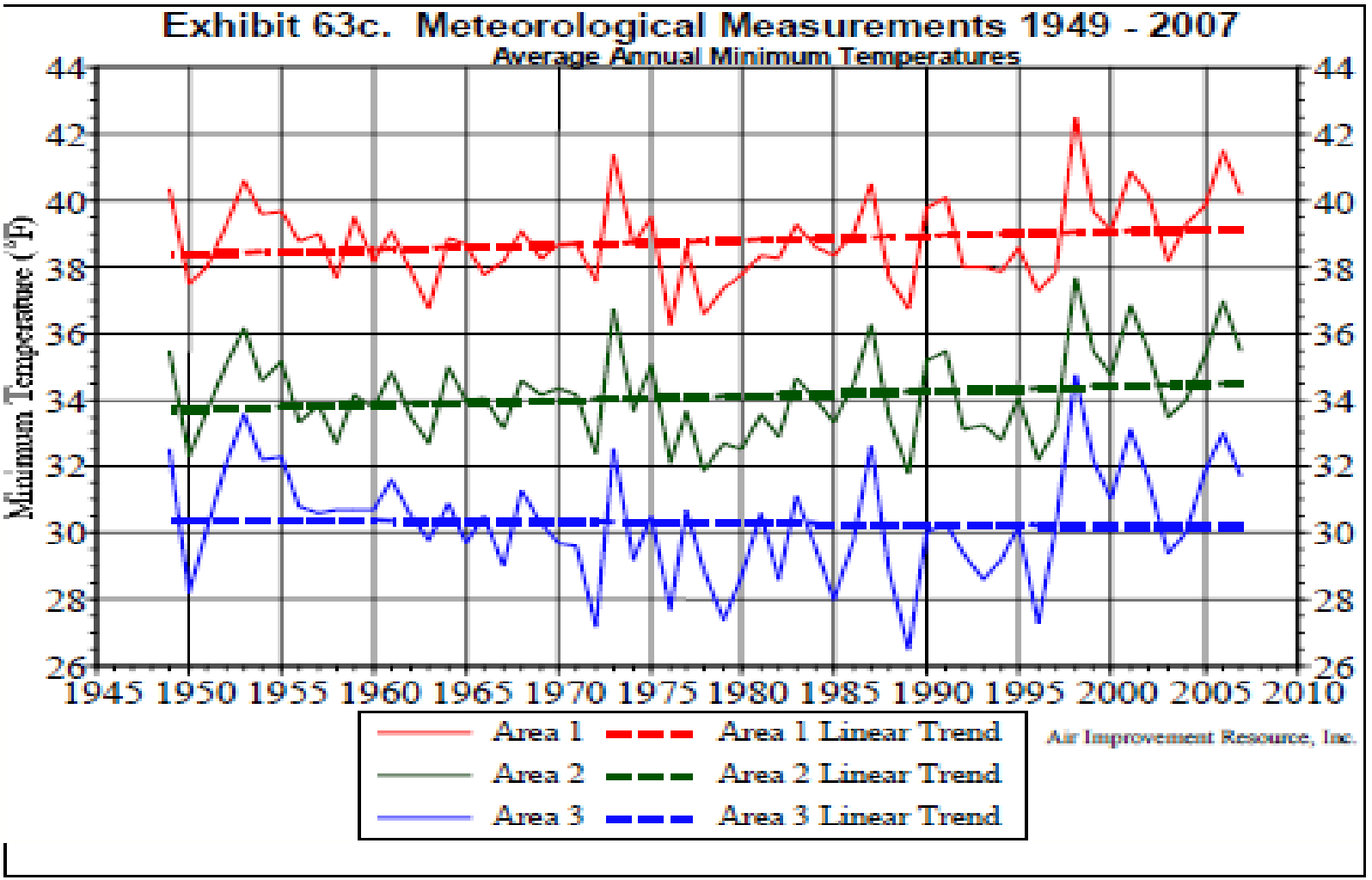
Total Annual Snowfall 1949 – 2007



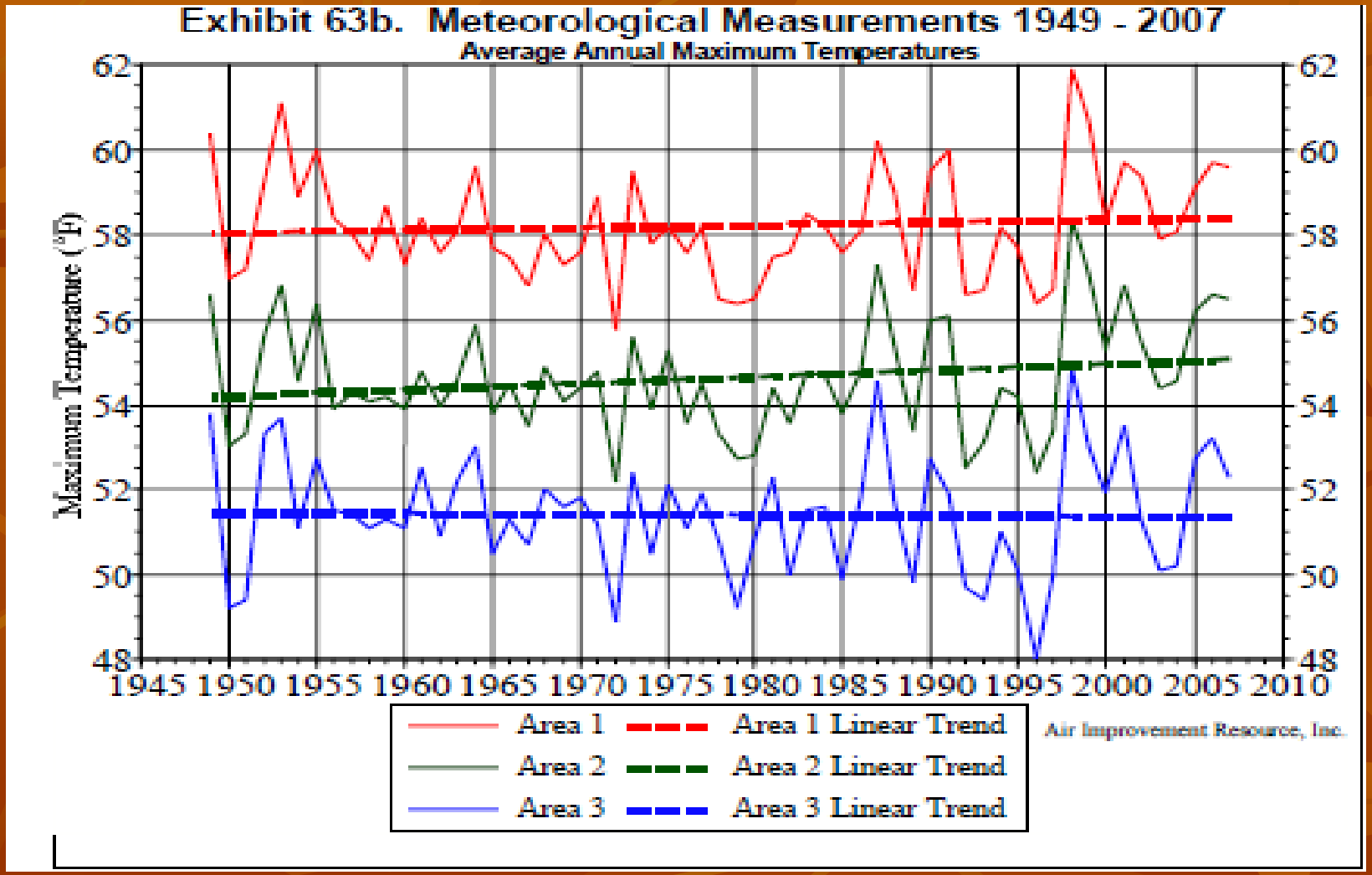
Environmental Measures – Physical/Chemical Indicators
Length of Growing Season **1949 - 2007**



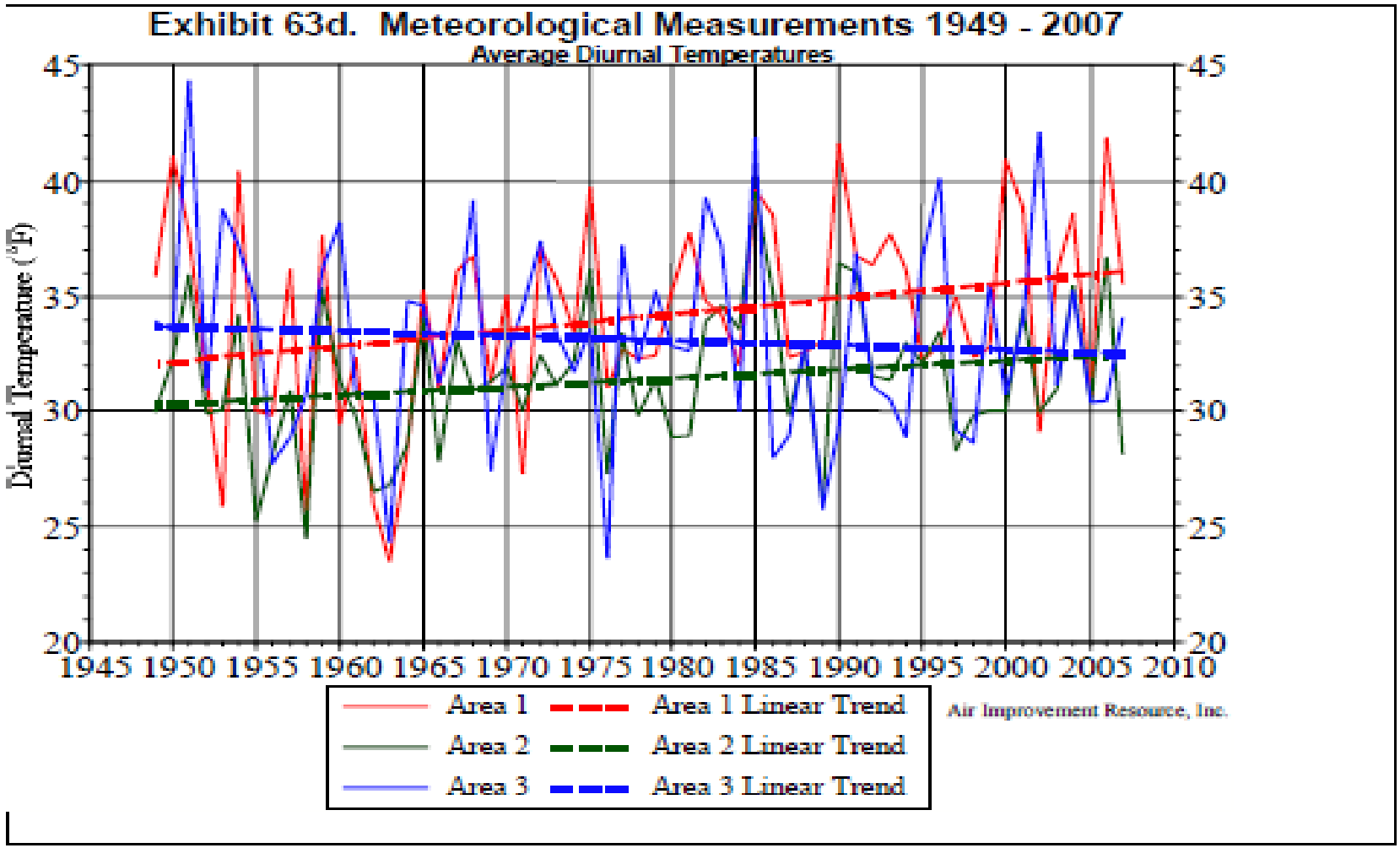
Environmental Measures – Physical/Chemical Indicators
Annual Average Daily Minimum Temperature **1949 - 2007**



Environmental Measures – Physical/Chemical Indicators
Average Annual Daily Maximum Temperature **1949 - 2007**

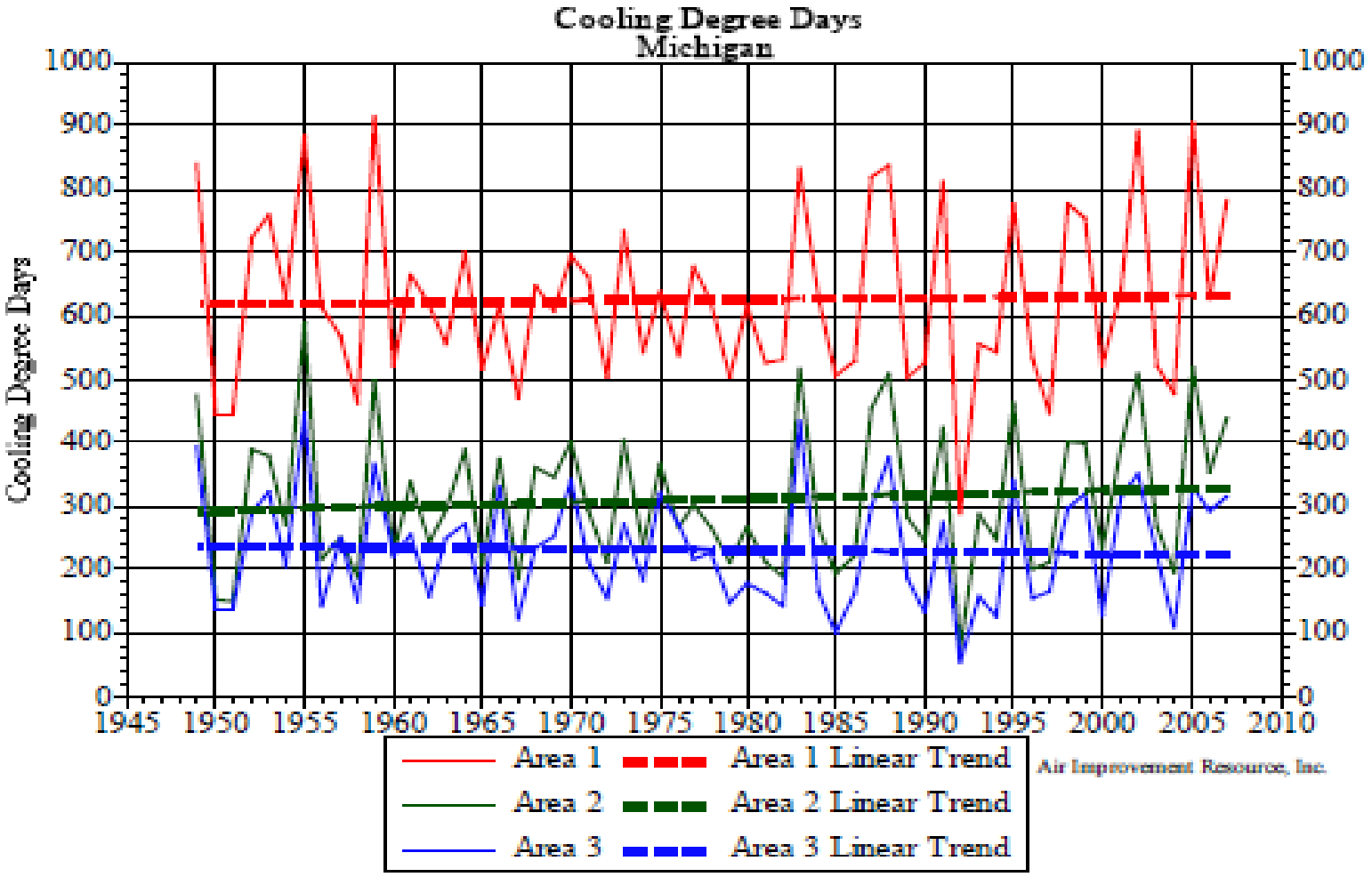


Environmental Measures – Physical/Chemical Indicators
Average Diurnal Temperature **1949 - 2007**

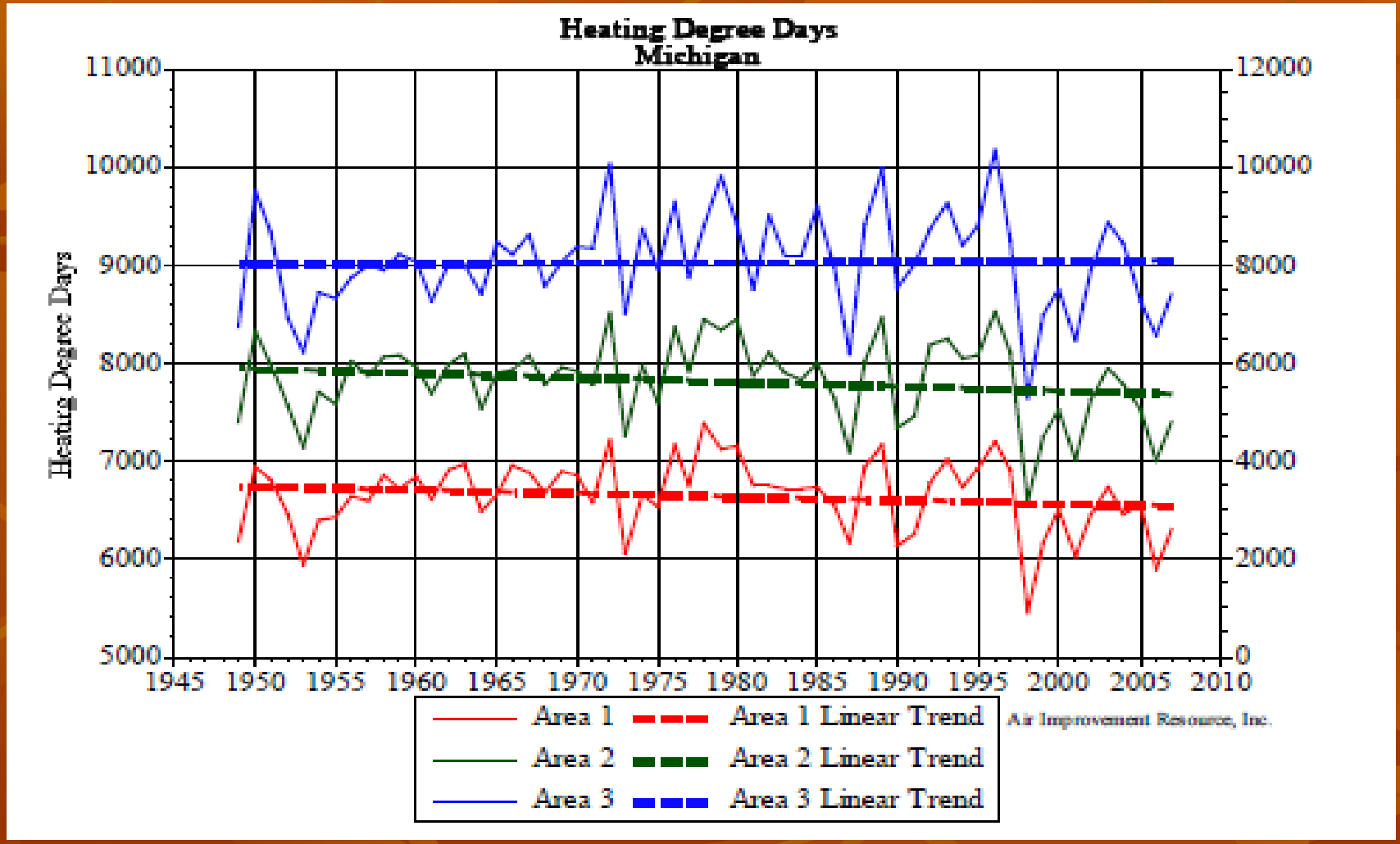


Environmental Measures – Physical/Chemical Indicators

Cooling Degree Days 1949 - 2007



Environmental Measures – Physical/Chemical Indicators
Heating Degree Days **1949 - 2007**



Environmental Measures – Physical/Chemical Indicators
Climate and Weather

- Michigan's climate has fluctuated for thousands of years and will continue to do so with time.
- However, based on available reliable scientific data, Michigan's climate, while certainly exhibiting cyclic behavior, has not *significantly* changed over the last 58 years.

State of Michigan's Environment 2008: First Triennial Report

Summary for Parts I - III

- In general, the available data clearly demonstrate that Michigan's air and water have significantly improved during the last 40 to 50 years.

- With the marked reduction of contaminants, the air has become clearer and cleaner, many of Michigan's lakes, rivers and streams have seen improvement, and many previously at risk animal species have been observed to again increase in both population and viability.

State of Michigan's Environment 2008: First Triennial Report

Summary for Parts I - III (continued)

- While clearly, many improvements in air and water can be seen, other problems have since surfaced. Many of these "new" concerns, however, really are not new. Most of them, such as non-point source pollution, urban sprawl, loss of habitat, exotic species, were around in the 1960s also. The difference is that impacts of most of these were overshadowed by the more dramatic impacts of the other contaminants. These are the areas where the state now needs to focus its attention.

- In addition to the above, we also can point to several issues that are just now beginning to be seen as problems and where little information exists regarding adverse impacts. These emerging contaminants of concern also will need the state's attention.

Additional Information Sources:

Michigan Department of Environmental Quality

www.michigan.gov/deq

Michigan Department of Natural Resources

www.michigan.gov/dnr

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Environmental Science and Services
Department of Environmental Quality
Constitution Hall, 1st Floor North
P.O. Box 30473
Lansing, Michigan 48909-7973

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Prepared by KGH Environmental PLC

www.kghenvironmental.com/